DUSEL Working Group 10
Geobiology

Co-coordinators

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1. Importance. Why DUSEL for Geomicrobiology

- Need for a dedicated site, with continuous long-term access, infrastructure, etc.
- Access to great depth (>3 km)
  - Test limits of life, depth of biosphere
  - Ecosystems based on H_2, “geogas”
- Monitor human impacts on the subsurface
- Biotechnical applications
  - In situ mining
  - Bioremediation
  - Novel enzymes, pharmaceuticals, etc.

2. What's missing?

What are the big questions in subsurface geomicrobiology?

- What energy and carbon sources are available in the deep subsurface? "Geogas"? What are the sources of H_2? Rates of H_2 generation? Independence from photosynthesis?
- Are these ecosystems suitable analogs for possible subsurface life on other planets?
- Are there subsurface microbes and communities that are selected for and adapted to the extreme conditions of the subsurface? Are there indigenous communities whose metabolism influences subsurface geochemistry?

2. What's missing?

What are the big questions in subsurface geomicrobiology?

- What are the in situ rates of metabolism?
- What adaptations do microbes have that enable persistence under extreme conditions?
  - Low nutrient flux, high temperature, extreme pH, high presssure, etc.
- How do subsurface microbes maintain/repair macromolecular structures?
- Do subsurface microbes represent early life on earth? First life on earth??

3. Technical requirements

- Access to multiple locations with varied geology (could be single or multiple sites)
  - Igneous, metamorphic, and sedimentary rocks
- Access to locations with geological interfases, geochemical gradients
- Access to pristine “green fields” (unmined, unimpacted by mining, not-reflooded)
- Access at multiple depths
- Access to a deep site (2-3 km) from which to drill/core through 121 C isotherm.
- Acess to ancient (> 1 Ma, prfereably >100Ma) groundwater

3. Technical requirements

- Periodic, scheduled excavation time windows
- ~20 drill sites over a long period
  - 500 sq ft, 10 m ht
- Many small drill sites
  - 200 sq ft, 5 m ht
- Test cells, up to 1 km^3, to be drilled, instrumented, etc.

3. Technical requirements

- Portable 200 kw generators for short-term use at remote locations
- Fiber optic communication with instrumented remote sites
- One-two 1000-sq ft underground labs (can share infrastructure with other disciplines)
- One 500 sq ft underground office
- Shared underground classroom, teaching lab, conference room